

CLAIMS

[0070] We claim:

1. A pedal operated recumbent bicycle or tricycle defined as:

- (a) a two or three wheel vehicle having a pedal mechanism for propulsion,
- (b) said pedal mechanism having a shaft rotatably mounted transverse to the vehicle structure and having a distance between the shaft rotational axis and a driven rear wheel axle centerline of 24 inches or greater and,
- (c) having means for transferring pedal power to a rear wheel or wheel pair and,
- (d) having a seat to support the rider in a position rearward of the pedal shaft and,
- (e) said seat having means in addition to simple friction between rider and seating surface to resist rearward motion of a rider exerting leg muscle force on the pedals and,
- (f) the lowest point of the seating surface of said seat being no more than 20 vertical inches above the rotational axis of said pedal shaft and,

said pedal operated recumbent bicycle or tricycle having an electric assist unit mounted roughly midway along an imaginary longitudinal line between the pedal shaft and the driven rear wheel axle and having a means for transmitting power to a rear wheel or wheels and a means for transmitting power received from the pedal mechanism to said rear wheel or wheels, said electric assist unit comprising:

- (a) a means for mounting the electric assist unit to the frame of said recumbent bicycle or tricycle,
- (b) a support means for holding the elements of the electric assist unit in the correct positions relative to one another,

- (c) an electric motor having a means of controllably varying output torque, power, or speed,
 - (d) said electric motor being coupled via an overrunning clutch to a speed reducing means,
 - (e) said overrunning clutch being arranged to allow the speed reducing means to be rotated at a speed faster than the motor shaft without driving the motor,
 - (f) said speed reducing means driving one or two rear wheels via a power transmission means,
 - (g) said power transmission means allowing the ratio of motor rotational speed to wheel rotational speed to be changed while in operation,
 - (h) the pedals of the recumbent bicycle or tricycle being coupled to said speed reducing means through another overrunning clutch such that the pedals may drive the rear wheels via the speed reducing means but will not be driven by the speed reducing means and,
 - (i) a source of electric current selected from the group consisting of capacitors and inductors and storage batteries and fuel cells and photovoltaic cells and thermoelectric devices.
2. A recumbent bicycle or tricycle as set forth in claim 1 further including a second seat and pedal mechanism disposed forward or in tandem with the first seat.
3. A recumbent bicycle or tricycle as set forth in claim 1 wherein the electric assist unit is detachable.
4. A recumbent bicycle or tricycle as set forth in claim 3 wherein a transmission means is provided for driving the rear wheel or wheels with the pedal mechanism after removal of the electric assist unit.
5. An electric assist unit for recumbent bicycles and tricycles comprising:
- (a) a means for mounting the electric assist unit onto a recumbent bicycle or tricycle between pedals and rear axle,

- (b) a support means for holding the elements of the electric assist unit in the correct positions relative to one another,
- (c) an electric motor having a means of controllably varying output torque, power, or speed,
- (d) said electric motor being coupled via an overrunning clutch to a speed reducing means,
- (e) said overrunning clutch being arranged to allow the speed reducing means to be rotated at a speed faster than the motor without driving the motor,
- (f) said speed reducing means driving one or more rear wheels via a power transmission means,
- (g) said power transmission means allowing the ratio of motor rotational speed to wheel rotational speed to be changed while in operation,
- (h) the pedals of the recumbent bicycle or tricycle coupled to said speed reducing means through another overrunning clutch such that the pedals may drive the rear wheels but will not be driven by the speed reducing means and,
- (i) a source of electric current selected from the group consisting of capacitors and inductors and storage batteries and fuel cells and photovoltaic cells and thermoelectric devices.

6. An electric assist unit as set forth in claim 5 having rear wheel drive chain and a means for guiding said rear wheel drive chain onto a sprocket on the electric assist unit so as to inhibit chain derailment.

7. An electric assist unit as set forth in claim 5 having a chain for transmitting power from pedals to the assist unit and having a means for applying tension to said chain so as to allow the bicycle to have a functioning front derailleur mechanism.

8. An electric assist unit as set forth in claim 5 having a means for sensing the force, energy, or power being transmitted from the pedals to the unit.